United States Patent [19]

Pereda

[11] **3,757,344**

[45] **Sept. 4, 1973**

[54] **SLOT ANTENNA HAVING CAPACITIVE COUPLING MEANS**

[76] Inventor: **Eugene F. Pereda**, 11621 Hughes Avenue, N.E., Albuquerque, N.M. 87112

[22] Filed: **Sept. 3, 1971**

[21] Appl. No.: **177,698**

[52] **U.S. Cl.** ..... **343/770**, 333/24 C, 343/881

[51] **Int. Cl.** **H01q 13/10**

[58] **Field of Search** ..... 333/24 C, 73 S; 343/700 A, 767–770, 798, 802, 820, 834, 839, 881

[56] **References Cited**

UNITED STATES PATENTS

2,632,851	3/1953	Lees et al.	343/768
2,915,716	12/1959	Hattersley	333/73 S
2,877,427	3/1959	Butler	343/770 UX
3,577,196	5/1971	Pereda	343/770
3,541,564	11/1970	Fisk	343/854 X

Primary Examiner—Paul L. Gensler

Attorney—Clarence A. O'Brien and Harvey B. Jacobson

[57] **ABSTRACT**

An antenna of the type having a rectangular driven slot formed in a foil radiation plane is coupled at opposed longitudinal edges of the slot to signal feed lines by capacitors formed by plate enlargements at the ends of the feed lines dielectrically spaced from the foil in which the slot is formed.

5 Claims, 8 Drawing Figures

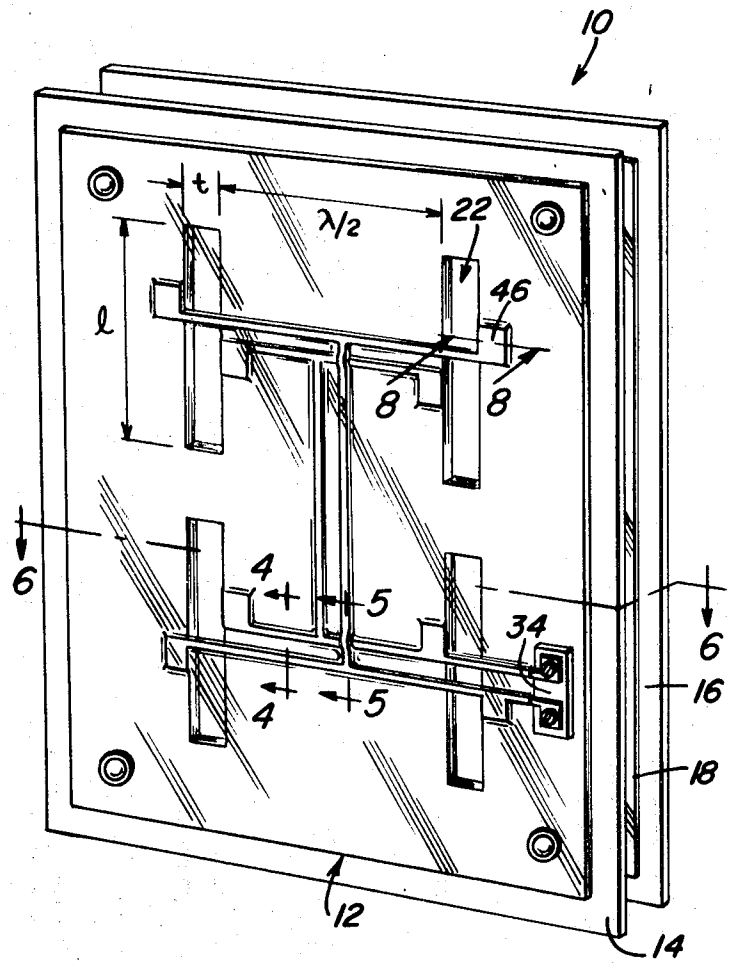


Fig. 1

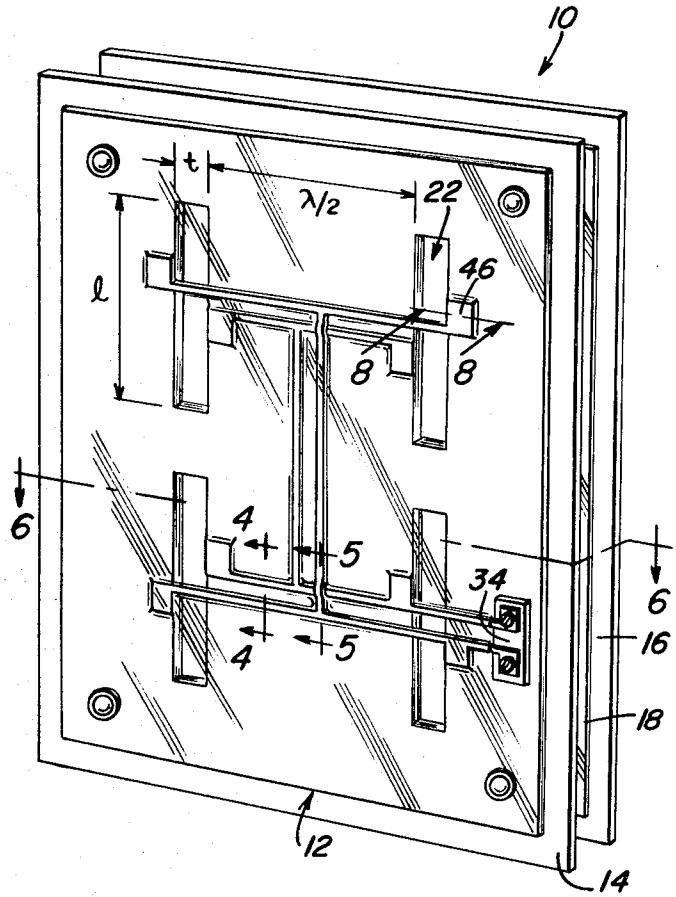


Fig. 2

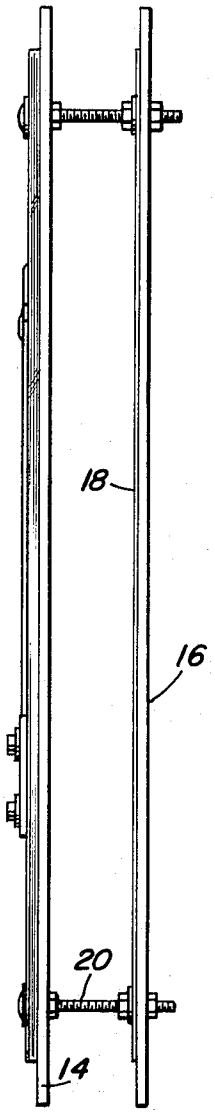


Fig. 3

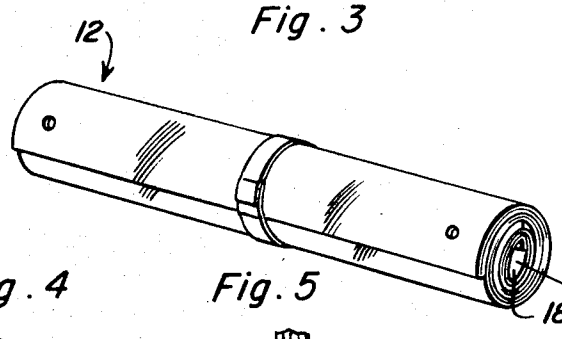


Fig. 4

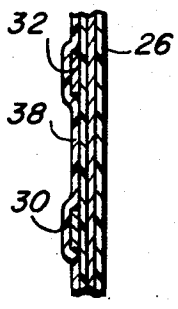
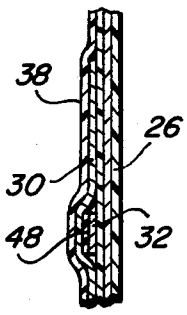


Fig. 5



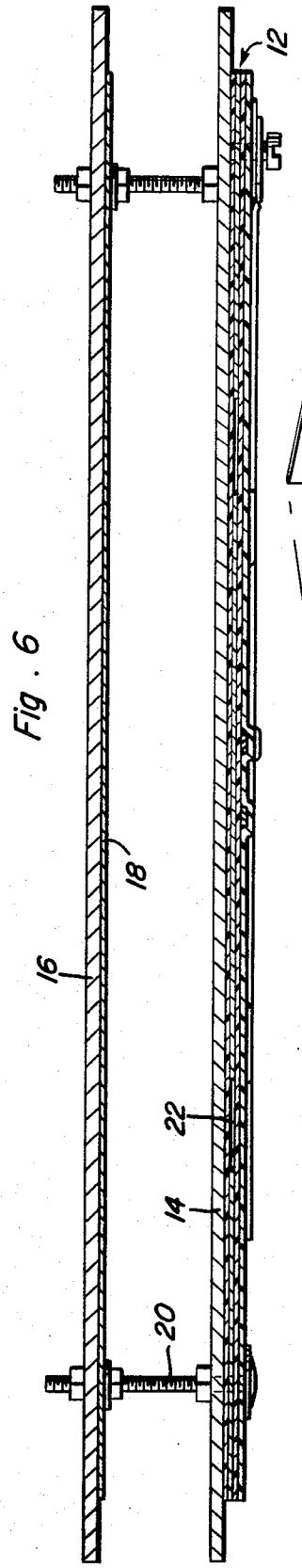


Fig. 6

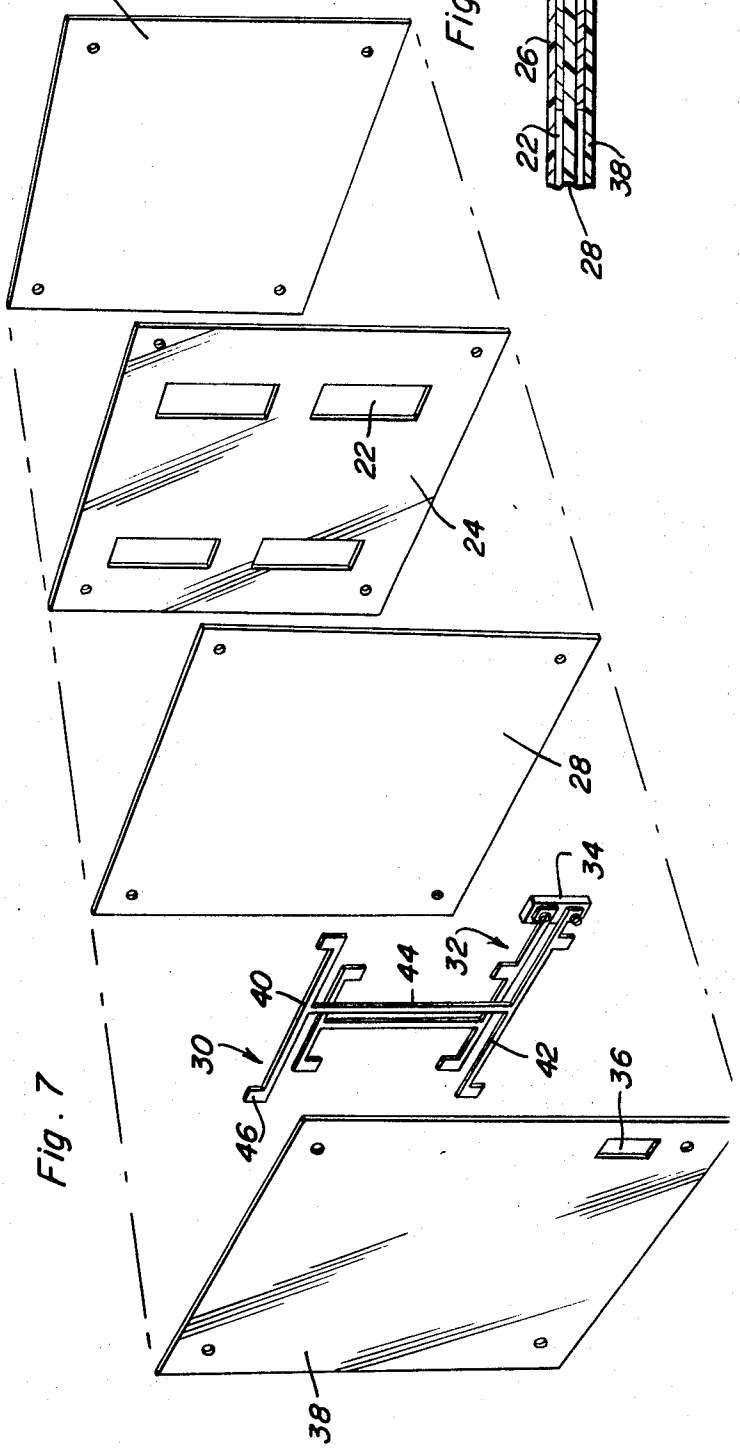


Fig. 7

Fig. 8

SLOT ANTENNA HAVING CAPACITIVE COUPLING MEANS

This invention relates to slot type antennas and more particularly to an improved slot antenna construction.

Slot antennas of the planar type are well known as disclosed for example in U.S. Pat. Nos. 2,507,528 and 2,794,184 as well as in applicant's own prior U.S. Pat. No. 3,577,196. As is well known by those skilled in the art, a slot antenna is related by Babinet's principle to dipole antennas having strip elements of a tuned length wherein the transmission feed lines are coupled to the opposite longitudinal edges of a driven slot in the foil sheet, intermediate the ends of the slot where maximum signal strength occurs. As disclosed in my prior U.S. patent aforementioned, the transmission feed lines are soldered to the foil sheet. Soldering of the transmission lines is not only a difficult and tedious operation but presents problems in the mass production of such antennas and also adversely effects the flexibility and compactness of a laminate assembly type of antenna construction. It is therefore an important object of the present invention to provide a flexible laminate type of slot antenna which avoids the soldering of transmission leads to the foil sheet within which the antenna slots are formed. A further object is to provide a slot antenna laminate construction capable of being fabricated with greater economy and ease.

In accordance with the present invention, a planar slot antenna array corresponding to an antenna curtain of four half-wave dipole elements backed by a reflector is formed from a flexible laminate assembly in which a foil sheet with thin rectangular slots is coupled to transmission feed lines in the form of conductive strips, by capacitive plate enlargements at the ends of the strips dielectrically spaced from the slotted foil sheet along the opposite longitudinal edges of the slots intermediate the ends thereof. The conductive strips extend from the various slots to a terminal connector exposed through an opening in an external protective layer of the laminate assembly.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a perspective view showing a typical antenna construction and installation in accordance with the present invention.

FIG. 2 is a side elevational view of the antenna shown in FIG. 1.

FIG. 3 is a perspective view showing the antenna laminate assembly in compact form for storage or transport.

FIG. 4 is a partial sectional view taken substantially through a plane indicated by section line 4—4 in FIG. 1.

FIG. 5 is a partial sectional view taken substantially through a plane indicated by section line 5—5 in FIG. 1.

FIG. 6 is a sectional view taken substantially through a plane indicated by section line 6—6 in FIG. 1.

FIG. 7 is an exploded perspective view of the components forming the laminate assembly.

FIG. 8 is a partial sectional view taken substantially through a plane indicated by section line 8—8 in FIG. 1.

Referring now to the drawings in detail, FIG. 1 illustrates one embodiment of an antenna construction made in accordance with the present invention generally referred to by reference numeral 10. The antenna configuration illustrated in FIG. 1 corresponds to a four half-wave dipole element arrangement with two pair of parallel slots in an opposed polarity feed arrangement, the slots of each pair being of the short slot design spaced apart by one-half wave length for UHF operation. This slot antenna construction is in the form of a laminate assembly generally referred to by reference numeral 12 mounted on a rigid panel 14 spaced by an adjustable amount from another panel 16 on which a foil reflector panel 18 is mounted. Any suitable adjustable spacing means 20 interconnects the panels 14 and 16 as shown in FIGS. 2 and 6. The distance between the panels is varied in order to achieve an approximately three decibel enhancement of the antenna gain at a selected frequency. Further, the antenna in the illustrated arrangement, is unidirectional.

Each of the slots generally referred to by reference numeral 22 in FIGS. 1 and 6, is related to the other slot in its pair by the transmission feed lines in an opposed polarity arrangement as aforementioned and each part is interconnected by the transmission feed lines in an in-phase or additive arrangement. It should however be appreciated that other feed arrangements may be utilized including an in-phase feed between the slots of each pair and/or an opposed connection between each pair. As denoted in FIG. 1, the thickness (t) of these slots, as is well known, is relatively small compared to the wavelength of the signal being handled and the length of the slots (l) is selected in accordance with well known criteria as indicated in the prior art patents aforementioned. The significant contribution of the present invention, resides in the manner in which the transmission feed lines are coupled to the slots and in the laminate construction associated therewith.

The laminate assembly 12 as more clearly seen in FIGS. 4 and 7, includes a planar conductor or aluminum foil sheet 24 within which the slots 22 are formed. The foil sheet is bonded on one side to a protective layer 26 and on the other side to a dielectric spacing layer 28. The foil sheet is thereby dielectrically and non-conductively spaced from a pair of conductive strip sections 30 and 32 constituting the usual 300 ohm transmission feed lines. The terminal ends of the conductive strip sections 30 and 32 are connected to a terminal connector 34 exposed through an opening 36 formed in an external or outer protective layer 38. Thus, the foil sheet 24, the dielectric layer 28, and the conductive strip sections, are sandwiched between the external protective layers 26 and 38 to form the flexible laminate assembly 12 capable of being rolled up into compact form as shown in FIG. 3. This laminate assembly as aforementioned, is mounted on the panel 14 in parallel spaced relation to the reflector foil sheet 18 on the panel 16.

Each of the conductive strip sections 30 and 32 includes parallel spaced portions 40 and 42 interconnected in-phase in the illustrated embodiment by a connecting portion 44 as more clearly seen in FIG. 7 with one of the parallel portions 42 being connected to the terminal connector block 34. The ends of the parallel

connector portion **40** are provided with enlargements **46** constituting a capacitive plate which is dielectrically separated from the foil sheet **24** by the dielectric layer **28** as shown in FIG. **8** so as to form a capacitive coupling between one transmission feed line and one longitudinal edge of an associated slot intermediate the ends thereof. Each enlargement **46** is accordingly positioned along a longitudinal edge of a slot **22**. The other parallel portion **42** of the conductive strip section is also provided with a pair of enlargements, one being at an end of the portion and the other being spaced from the terminal connector block **34**, in order to be positioned along longitudinal edges of associated slots. Capacitive plate enlargements are similarly formed on the conductive strip section **32** for positioning along the other longitudinal edges of associated slots longitudinally spaced by a small amount from the capacitive plate enlargements along the opposite longitudinal edges of the slots. Inasmuch as the two conductive strip sections must be non-conductively spaced from each other, the strip section **30** is shown overlying the strip section **32** and an insulative spacer **48** is positioned between the strip sections where they cross as shown in FIG. **5**.

It will therefore be apparent, that transmission feed lines may be connected to the conductive strip sections through the terminal connector **34** in order to establish a signal feed between the antenna assembly and the receiver through the conductive strip sections **30** and **32**. The enlargements **46** form capacitive couplings to the slots thereby avoiding solder connections. The formation of the capacitive plates as enlargements **46** of the conductive strip sections, facilitates the fabrication and installation of the feed arrangement as part of the flexible laminate assembly **12** which may be mounted in a vertical antenna plane as illustrated for vertical polarization. For UHF operation, of the antenna, the capacitive plate enlargements **46** must have a minimum area of 0.6 square inches. For the particular array of slots of the antenna as illustrated in combination with the adjustably spaced reflector sheet **18**, the antenna is unidirectional and is characterized by high gain at the selected frequency to which it is tuned by selection of the slot lengths (l).

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. In an antenna, a foil layer serving as a planar surface in which a driven element slot is formed having opposite longitudinal edges, a conductive strip serving as a signal feed line, and means for effectively coupling the signal feed line to only one of said longitudinal edges of the slot intermediate the ends thereof comprising an abrupt enlargement of the conductive strip serving as a capacitive plate and means dielectrically spacing the enlargement from the foil layer along said edge of the slot, said dielectric spacing means comprising a flexible layer of dielectric material to which the conductive strip and enlargement are bonded on a side opposite the foil layer to form a laminate assembly.

2. The combination of claim **1** including a terminal connector connected to an end of the conductive strip opposite the capacitive plate enlargement.

3. The combination of claim **2** including external protective layers coating the foil layer and the conductive strip with the enlargement, one of the protective layers having an opening through which the terminal connector is exposed.

4. In an antenna, a planar conductive having a slot formed therein, said slot being defined between a pair of spaced edges, two relatively narrow signal conductors, means dielectrically spacing said planar conductor from said signal conductors, and capacitive means connected to said narrow conductors for effective coupling thereof to the planar conductor only at said edges of the slot, said capacitive means comprising abrupt enlargements of the narrow conductors, said dielectric spacing means being formed by a single flexible layer of dielectric material to which the signal conductors and enlargements are bonded to form a laminate assembly with the planar conductor.

5. The combination of claim **4** including a terminal connector connected to ends of the signal conductors opposite the capacitive means.

* * * * *